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ON THE

PREVALENCE OF ENTOZOA IN THE DOG,

WITH

REMARKS ON THEIR RELATION

TO

PUBLIC HEALTH.

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DESPITE the rapid advances of heminthological science, it is not yet sufficiently well understood how intimately connected are the relations subsisting between man and the domestic animals in reference to entozootic diseases. Whilst our very existence is dependent upon a supply of certain animals, as sources of food and aids to civilization, it can nevertheless be shown that under certain circumstances any one of the most valued of our domestic quadrupeds may become an occasion of discomfort, disease, or even death. The truth of this general statement is sufficiently

obvious in cases of ordinary accident, and also in those diseases (hydrophobia for example), whose nature is either doubtful, or which, at the least, cannot be said to have a parasitic origin; but it comes out much more forcibly when we confine our attention exclusively to evils arising from entozoa harboured by our domesticated animals in their capacity as "intermediary bearers." In this communication I select the Dog as pointedly illustrating the correctness of the proposition just advanced; but, at the same time, I may add that, excepting perhaps the equine quadrupeds, I know of no important domestic animal which is not liable, by the agency of its parasites, to inflict on the human body one or other of the injuries just referred to—namely discomfort, disease, or death.

I may be permitted also to remark at the outset that all our researches, and especially those of the experimental kind, tend to show how the evils just mentioned may be averted; and many of our investigations having, in the first instance, a purely scientific object have materially strengthened the results obtained by other researches having merely a practical aim. It may be said that the two methods should go hand in hand, or, at least, *pari passu*, in order to ensure brilliant results. Already helminthologists have obtained a considerable success; but it is just one of those successes in which the principal promoters are left without reward. Self-imposed tasks of this kind are more or less the prerogative of all the votaries of science, who, at least, have the satisfaction of knowing that they contribute to the public good.

To simplify and limit the subject matter before us, I offer, at once, a complete and revised list of all the entozoa (species varieties, and larvæ) at present known to infest the dog. In many respects it is interesting to contrast this, as a whole, with the rather more extended list of human entozoa which I have previously communicated to the Zoological Society; but, as will hereafter be seen, the mutual relations subsisting between certain members of the two series can only be established by a somewhat detailed notice respecting the individual forms. These are as follows:—

1. *Holostoma alatum*, Nitzsch.
2. *Spiroptera sanguinolenta*, Rudolphi.
3. *Dochmius trigonocephalus*, Dujardin.
4. *Trichosoma plica*, Rudolphi.
5. *Trichocephalus depressiusculus*, Rudolphi.
6. *Trichina spiralis*, Owen.

7. *Ascaris marginata*, Rudolphi.
8. *Eustrongylus gigas*, Diesing.
9. *Bothriocephalus latus*, Bremscr.
10. *B. cordatus*, Leuckart.
11. *B. fuscus*, Krabbe.
- " " var. *reticulatus*, Krabbe.
- " " var. *dubius*, Krabbe.
12. *Tænia marginata*, Batsch.
13. *T. cænurus*, Kuchenmeister.
14. *T. cucumcrina*, Bloch.
15. *T. serrata*, Goeze.
16. *T. litterata*, Batsch.
17. *T. echinococcus*, Siebold.
18. *Pentastoma tænioides*, Rudolphi.
19. *Cysticercus (telæ) cellulosæ* }
20. *Filaria trispinulosa* } larval forms.
21. *F. sanguinis*

The above list, large as it is, might be very much extended if one chose to regard as true species a number of particular forms and varieties described by authors under other names. I could show, however (if it were the express object of the present paper to do so), that most, if not all, of the forms referred to are in point of fact identical with those here provisionally admitted to be distinct. Probably the list is somewhat too extended as it is; yet, meanwhile, I purposely refrain from entering at any length upon the exclusively zoological aspects of the question. In other words, I wish it to be understood that, as regards several of the forms here enumerated, I do not pledge myself to affirm that they are specifically distinct. Nevertheless, taking them up serially in the order given, I have a few remarks to offer respecting each; and fortunately the end proposed will enable me to restrict my observations on certain forms within the narrowest possible limits.

1. *Holostoma alatum*.—Flukes are sparingly found in the carnivorous mammalia generally; therefore the Trematoda being represented by a single species in the dog need not excite surprise. Though rare in the dog, this fluke is not uncommon in its congeners, the Fox and Wolf. Under a variety of names its structure and relations have been carefully studied; but there is no ground for supposing that its existence is either directly or indirectly injurious to man.

2. *Spiroptera sanguinolenta*.—I am not aware that any one has

distinctly indicated the presence of this parasite in dogs dying or destroyed in this country; but it appears to be tolerably frequent in France and Germany. I believe it to be identical with the round-worm, which is known to be common in China and not unfrequently to cause the sudden death of its canine host. Some years ago a manuscript was placed in my hands, giving a detailed account of the ravages inflicted by these parasites; but I fear the paper has been irretrievably lost. Dr. Hughes Bennett, of Edinburgh, has in his possession a Chinese dog's heart which had burst during life from the pressure occasioned by a large number of these parasites lodged in the ventricles. In the year 1813 a round worm, probably referable to this species, was found in the heart of a dog at Paris; and there is some probability that the microscopic hæmatozoa, first discovered by Grube and Delafond in the blood of dogs, are genetically related to this species. I shall again have occasion to remark upon this point*.

3. *Dochmius trigonocephalus*.—This small parasite is probably not uncommon in this country, but it is either frequently overlooked or disregarded on account of its apparent unimportance. It is not likely that the migrating progeny are the source of the verminiferous condition of the blood just alluded to. Its prevalence is certainly very variable in different countries or districts; but the only accurate observations bearing upon this point are those given by Dr. Krabbe in his recent Danish work†. Out of 500 dogs which he had examined (after death) at the Royal Veterinary and Agricultural College at Copenhagen, only nine contained this parasite, whilst in 100 dogs dissected in Iceland it was entirely wanting. His experience, as regards its prevalence in other members of the canine race, coincides with that of ob-

* Since this paper was announced I have received a letter from Dr. Jones Lamprey (Surg. 67th Reg.), confirming the facts above mentioned. Writing on the 15th inst., he says:—"I take the liberty to inform you that I have found some remarkable entozoa in the cavities of the hearts of dogs in China, which I have sent to the Museum of the Army Medical Department at Netley, together with an account of them. I do not believe they have been, as yet, described." I (Dr. C.) may also add that since this paper was read I have reexamined Prof. Bennett's preparation, and, by his permission, have removed and retained one of the parasites. It measures exactly 10 inches in length.—T. S. C.

† Helminthologiske Undersøgelser i Danmark og paa Island, med sæligt Hensyn til Blæreormlidelserne paa Island. Af Dr. med. Krabbe. Kjøbenhavn, 1865. [The above facts are taken from the Danish work; but Dr. Krabbe has since brought out a French edition of his treatise, and has likewise, through M. Blanchard, communicated a résumé of his researches to the French Academy.—T. S. C.]

servers generally ; for he found this entozoon in three Danish foxes, and also in a blue or Arctic fox (*Canis lagopus*) which died in Dr. Kjarbolling's menagerie. It is worthy of remark that the last-named animal had originally come from Iceland. The importance of noticing these particulars and of indicating all the rarer forms of canine entozoa will appear in the sequel.

4. *Trichosoma plica*.—This parasite, like the previous species, is much more common in the fox than in the dog ; but the possibility of its occurrence in the latter should be born in mind. So far as I am aware, the only direct proof we have of its liability to infest the dog rests upon the statements of Dr. Bellingham. The circumstance of its not inhabiting the alimentary canal will readily account for its not having been often seen although it should afterward turn out to be comparatively frequent in occurrence. The organization of the species has been sufficiently well investigated by Rayer ; but its precise genetic relations remain to be cleared up. It is by no means improbable that the progeny of the preceding species, as well as of this entozoon and of the form next to be noticed, passes through phases of development closely resembling those of *Trichina*. Thus it may happen that an inexperienced observer finding these larvæ, in the act of migrating, in the flesh of any "host" might be induced to conclude that he had discovered examples of the fleshworm-disease, when in truth he had only encountered the offspring of parasites totally distinct. Mistakes of this kind have occurred over and over again in reference to a minute and little-known parasite which infests the cat ; and doubtless nearly all the sexually immature forms of parasites described as new species by their respective discoverers are the offspring only of some of their more or less familiarly known representatives.

5. *Trichocephalus depressiusculus*.—This parasite is likewise common to the dog and fox, and, though on the whole more prevalent in the former, cannot be said to be frequent in either. I have only seen one or two examples. Out of 144 dogs dissected at Vienna it was only noticed four times ; and in sixty-two foxes examined at the same place, not one was encountered. On the other hand, Dujardin found this species present in two out of seven foxes dissected by him at Rennes. It does not appear to have come under Dr. Krabbe's observation in any of the 600 dogs which he examined in Denmark and Iceland. I regret that I retain no accurate data respecting the prevalence of this and several other of the less frequent parasitic forms which I have

encountered from time to time in dogs. Until lately the value of such peculiar statistical records, in reference to our domestic animals, did not fully strike me; but from 1855 to 1864 inclusive I noted down all the parasites encountered in less common "hosts." Part of the fragmentary results thus obtained I have already communicated to the Zoological Society*.

6. *Trichina spiralis*.—This interesting parasite is probably not indigenous, so to speak, in the dog; but the ease with which it may be transmitted, and the frequency of its introduction by experiment, oblige us now to class the fleshworm with other canine entozoa. Until lately it was supposed that *Trichina* might be made to infest any warm-blooded animal; but recent experiments (conducted by Mr. Simonds and myself at the Royal Veterinary College in London, and on a more extended scale by Drs. Pagenstecher and Fuchs at the Zoological Institute at Heidelberg) incontestably prove that the fleshworm, as such, cannot be reared in birds. Having already offered a detailed account of these experiments to the Society, it is only necessary that I should remark that I have repeatedly reared *Trichinæ* in the dog from the flesh of man and animals. Except in a very indirect manner, the dog itself is scarcely likely to communicate the fleshworm disease to man; nevertheless if the flesh of a trichinized dog were eaten by us, the malady would be readily propagated. There would moreover be considerable danger in allowing trichinized dogs to roam at large; for the consumption of their flesh (after death) by other animals, such as rats, for example, would convey the disorder to new "hosts," which again might convey it to the pig, and ultimately to man. It has, indeed, been fully proved that in some instances swine have been infected by eating dead rats and the decomposing remains of other trichinized animals; and it is quite certain that rats, not previously made the subject of experiment, have been found to contain *Trichinæ* in their muscles. Dr. Krabbe informs me, by letter, that he has discovered trichinized rats in Copenhagen; and the same thing has been noticed in Germany. Dogs and cats alike may also become infected from this source. Bearing in mind, therefore, the variety of sources whence the dog may obtain *Trichina*, no one need in future be surprised at finding this animal affected with the disease; and since the malady is so readily transmissible, care should be taken to destroy, thoroughly, all trichinized animal flesh wherever and whenever encountered. In illustration of the facts above

* 'Proceedings,' for March 26, 1861.

given, I may mention that I have caused *Trichinæ* to be transferred from the flesh of man to a hedgehog, then from the muscles of this hedgehog to a dog, and ultimately from the dog to a pig. It was in this last-named animal that I obtained about 15,000,000 *Trichinæ*—enough to have trichinized half the inhabitants of London, could each individual have been induced to partake of a minute portion of the uncooked flesh. As it was, I had some difficulty in persuading bystanders at the *post mortem* dissection that the perfectly healthy-looking flesh had anything the matter with it; and one person actually carried off the heart of the animal as a perquisite. Fortunately *Trichinæ* do not stay in the substance of the heart, although they pass through it; and thus the lucky person who ate the heart could by no possibility have sustained any injury, even if it were insufficiently cooked. Lastly, I will only add that I consider further experiments with *Trichina spiralis* unnecessary, and even undesirable from a hygienic point of view.

7. *Ascaris marginata*.—Of all the parasites infesting the dog in England this species is the commonest. I have met with it in about thirty out of forty dogs dissected by myself and friends. It does not appear to be quite so common abroad; nevertheless, out of 144 dogs dissected at the Vienna Museum, it was present in no less than 104 instances. At Copenhagen Dr. Krabbe found it present 122 times out of 500, or in 24 per cent. of the dogs he examined; but in Iceland, where other forms of canine entozoa are extremely abundant, only two dogs out of 100 were found to entertain this species. Fortunately the common roundworm of the dog is a very harmless parasite, so far as the health of the people is concerned, and it is apparently only in exceptional instances that it proves injurious to the dog itself.

8. *Eustrongylus gigas*.—This species is probably the rarest of canine entozoa. The only specimen which I have seen as coming from the dog is the very perfect one preserved in the Museum of the Royal Veterinary College, London. Probably not one in 5000 dogs harbours this entozoon; but since it is liable to occur in man, and has several times been noticed in the congeners of the dog, the possibility of its becoming more frequent should be considered. The Museum of the Royal College of Surgeons, London, contains some fine examples and several dissections of this parasite.

9. *Bothriocephalus latus*.—Although there is some difficulty in determining the number of species of *Bothriocephalus* liable to

infest the dog, it is generally agreed that this form is both human and canine, so to speak. In either case it is believed that the "host" acquires possession of the parasite by the consumption of fish. Dr. Knoch, of Petersburg, believed he had succeeded in rearing this species in dogs by direct experiment with its embryos; but the necessity of an "intermediary bearer" has been clearly established by Leuckart. The presence of *Bothriocephali* in the dog in this country is very rare. One such cestode may be seen in the Museum of the Royal Veterinary College; and no doubt can be entertained that it belongs to this species.

10. *Bothriocephalus cordatus*.—This form is quite distinct from the above, and seems to be very abundant in the dogs of North Greenland, where it also occasionally infests the human body. In the dog it occurs in considerable numbers, and can scarcely fail to occasion the animal more or less distress; but we have no evidence to show that it gives rise to any inconvenience in the human subject, where, so far as is at present known, it either exists singly or in very small numbers. Its comparative abundance in the dog doubtless depends upon the more ready access which that animal has to the uncooked food containing the larvæ, which latter are supposed to abound in marine fish.

11. *Bothriocephalus fuscus*.—Dr. Krabbe, of Copenhagen, described a variety of pit-headed tapeworms obtained from dogs in Iceland, all of which appear to be distinct from the above species. He recognizes three separate kinds (*B. fuscus*, *B. reticulatus*, *B. dubius*), severally presenting marked features of their own; but he is not prepared to affirm that these characters have any specific value. I do not now discuss this point, but I may remark, in passing, that the preparations of *B. cordatus* sent me by Prof. Leuckart, and the specimens of *B. fuscus* presented to me by Dr. Krabbe, afford convincing proof of the distinctness of these two forms. Taking the *Bothriocephali* as a whole they only occur in the ratio of 5 per cent. in Iceland, whilst Dr. Krabbe's investigations also show that in Denmark they are very much less frequent. In the 500 dogs examined at Copenhagen he only found one infested. It is by no means improbable that one or other of the forms will be discovered in this country.

12. *Tænia marginata*.—The tapeworms, properly so called, are far more numerously represented than the *Bothriocephali*; and this is one of the commonest forms. The frequency with which I have encountered it leads me to conjecture its presence in at least 25 or 30 per cent. of our English dogs. In Denmark it is

rather less abundant, being found, according to Krabbe, in 14 per cent. whereas in Iceland it is remarkably prevalent, occurring in no less than 75 out of the 100 dogs which he examined. This parasite is seldom found alone, and, being the largest species liable to infest the dog, proves a formidable guest to its canine host. Up to the present time it has not been described as occurring in man; nevertheless I have seen portions of a tapeworm, apparently referable to this species, which I was assured had come from the human subject. From the first, I expressed the strongest doubts as to its source. The dog acquires this parasite by swallowing the large cestode larvæ which are frequently attached to the viscera of the sheep. Dr. Möller, as is well-known, tried to rear this parasite in himself, by swallowing the fresh uncooked larvæ (*Cysticercus tenuicollis*), but he did not succeed; and consequently we are not at present warranted in concluding that this species can under any circumstances develop itself in man. Mr. Simonds and myself have succeeded in rearing several examples of this entozoon in the dog by direct experiment. One or two instances are on record of the occurrence of the larvæ of this species in man; and I have myself pointed to affirmative evidence in yet another case. In none of these examples is there any reason to suppose that the larvæ in question did any harm; yet it would be very unadvisable to allow of steps being taken which could promote its more frequent development within the human host. Sewage-distribution where dogs abound would aid in securing this undesirable end.

13. *Tænia cænurus*.—This species is likewise obtained from the sheep, though by no means exclusively so, as some imperfectly informed persons seem to suppose. Its prevalence in the dog, however, is comparatively rare. I have succeeded in rearing it without any difficulty, but I do not remember to have encountered the entozoon in any dog which had not previously been made the subject of a *Cænurus*-worm-feeding. I need hardly say that its larval form (*Cænurus cerebralis*) gives rise to the "gid" in flocks; but it also proves detrimental to several other animals. Indirectly, therefore, it affects man himself; yet, in this country, the "gid-disease" is seldom sufficiently prevalent to cause serious loss to the sheep-breeder. In other countries, Hungary for example, losses on this score are said to be very considerable. In Denmark Dr. Krabbe encountered this entozoon in only 1 per cent. of the dogs he dissected, but in Iceland he found it in no less than 18 per cent. Clearly the "gid" must abound in that country. It is

not generally known, even by those who have some acquaintance with helminthological matters, that the larvæ of this tapeworm sometimes infest the rabbit, giving rise to a formidable disease having its seat in the muscles and soft parts of that animal. In a paper communicated to this Society, I have already explained that Mr. C. B. Rose, F.G.S., was the first to direct attention to this important fact; but his explicit statements on this head have been either carelessly overlooked, or purposely disregarded. I regret to observe that there are persons who, whilst fairly recording the information they obtain from foreign writers, appear to be studiously careful to avoid giving credit to the labours of their own countrymen. In the curious discovery before us we have another unexpected source indicated whence the dog may obtain the adult parasite, and thus, in its turn, afflict another group of creatures with the so-called bladder-worm disease.

14. *Tænia cucumerina*.—Without doubt this is the commonest of all the forms of canine entozoa. I have little hesitation in saying that it is present in two out of every three dogs at present living in this country, excluding puppies up to three months old. Krabbe found it present in 48 per cent. at Copenhagen, and in 57 per cent. in Iceland. It appears to be very prevalent throughout Europe, and probably is more or less so in all other countries. So far as we know, the cucumerine tapeworm is a tolerably harmless parasite; but, notwithstanding the efforts of investigators, nothing certain is understood respecting its true larval source. In the adult state it sometimes occurs in prodigious numbers, and often associated with other parasites. In one valuable animal, a pointer, which died suddenly, I found between 500 and 600 of these parasites, associated with numerous examples of three other kinds of entozoa. Clearly, in this particular instance, entozoa were the cause of the dog's death. If the canine tapeworm species, *which are dangerous* to human life, became as abundant in this country as the harmless *Tænia cucumerina* is thus shown to be, our mortality would be increased by many thousands annually. This will be made more apparent in the sequel.

15. *Tænia serrata*.—Though by no means so abundant as the preceding, this form is nevertheless sufficiently common, whilst it is also more injurious to the bearer. Taking one variety of dog with another, I should say that it occurs in at least five per cent. of our English dogs; but in harriers and greyhounds I have little doubt that its presence is all but invariable. At Copenhagen Dr. Krabbe only encountered this parasite once; and in Iceland it

seemed altogether wanting. The practice of giving the viscera of hares and rabbits to sporting dogs (which I have myself occasionally witnessed in the field) will always ensure its prevalence in this country. On five or six separate occasions I have reared this tapeworm in dogs by the administration of the larvæ (*Cysticercus pisiformis*) taken from recently killed rabbits. It is one of the most easily reared of all the canine parasites, and, if due attention be paid to the form and size of the head and its conspicuous crown of hooks, cannot well be confounded with its allies. The older helminthologists are not trustworthy respecting the prevalence or otherwise of this species on the continent, since they regarded several distinct forms as identical. Even Dujardin was sceptical respecting the distinctive characters, severally, of *Tænia serrata*, *T. marginata*, and *T. crassiceps* (of the fox).

16. *Tænia litterata*.—This well-marked form is described by Dr. Krabbe under the name of *T. canis lagopodis*; but notwithstanding the priority of Rudolphi, I prefer the subsequent and more distinctive nomenclature of Batsch, especially also because the parasite is not by any means peculiar to the Arctic Fox (*Canis lagopus*). Here we know nothing of this parasite; and it may be that it does not exist in England. On the other hand, its general resemblance to *Tænia cucumerina* may have caused it to be overlooked. It seems from Krabbe's extended researches to be altogether wanting in Denmark; but in Iceland he found it in 21 of the 200 dogs which he there dissected. In the absence of any definite knowledge respecting its larval source, it may be assumed, as regards man, to rank amongst the so-called harmless species. The joints (judging from the specimens kindly sent me by Dr. Krabbe) have somewhat the appearance of those of *Bothriocephali*, owing to the central and ventral disposition of the reproductive organs. The orifices themselves, however, are not actually visible, though probably present in thoroughly mature segments.

17. *Tænia echinococcus*.—I come now to speak of a parasite of the highest interest in relation to public health. Though fortunately extremely rare in the adult condition, it is nevertheless sufficiently abundant to produce occasional fatal results by means of its larvæ. What is the actual amount of human mortality thus annually caused in this country it is not easy to say; nevertheless I know it to be something considerable; and there is reason to fear, in the absence of due precautions, that it may become much greater. The larvæ or *hydatids* are familiar to every hospital

surgeon. The adult parasite has frequently been reared by foreign experimenters ; but although several hydatid-feedings have been administered to dogs in England, only one such feeding has, so far as is known, been attended with positive results. This instance has recently been communicated to the Royal Society, the experiment having been made by Mr. Edward Nettleship*. I am sorry to believe also that I may have previously reared this parasite. I say "sorry," because the subject of the experiment, a small black dog, was liberated, by an ill-designing person, a few hours before the time I had appointed for destroying it. It is true that I had previously, in one or two other dogs, obtained only negative results ; but in those instances none of the conditions likely to ensure success were so favourable as in the case of the liberated animal. At all events, Mr. Nettleship, following up the experiment after a precisely similar method to that I had adopted, obtained a complete success. The freedom of one animal harbouring *Tænia echinococcus* must be fraught with serious danger to the community ; and yet it is to be feared that at the present time several dogs thus infested roam at large in this country. Certainly I have no desire to add to their number. In Copenhagen Dr. Krabbe encountered this parasite in *two* only out of 500 dogs ; and yet the parasite is probably more abundant in Denmark than in England. In Iceland, on the other hand, where the mortality from the hydatid- or echinococcus-disease embraces one-sixth of all who die in that country, Dr. Krabbe found 28 dogs out of 100 harbouring this entozoon. Up to the present time no person, I believe, in England has seen this parasite in any dog which had not previously been made the subject of experiment.

In order to obtain an approximately correct notion as to the amount of echinococcus-disease prevalent amongst us, I devoted some three or four weeks in the winter of 1864 to an examination of the collections of entozoa contained in nine of the principal Pathological Museums of the metropolis. The results of this search, independently of data derived from other sources of evidence, have convinced me that hydatids are far more prevalent than is generally imagined. In these collections I found no less than 195 instances of hydatid-disease out of a total of 368 cases of helminthiasis of all kinds. It is my deliberate belief that not less than 400 deaths annually occur in England from this source. Doubtless, if one could acquire correct statistical evidence re-

specting the amount of fatality from all the entozootic diseases combined, the rate of mortality from parasites would be considerably larger than this figure, by itself, implies; yet it fortunately happens that comparatively few of the other kinds of entozoa at present prevalent in England lead to fatal results. Such cases are exceptional. It is equally certain, on the other hand, that much misery and discomfort is produced by the less hurtful species. A very great deal of good might accrue from the acquisition of more extended evidence respecting the prevalence or otherwise of all the known forms of entozoa infesting man and the domestic animals in this country. A report of this kind, drawn up somewhat after the fashion of the present communication, would, I conceive, prove highly useful. Such a report should not be a mere record of helminthic epidemics collected from foreign sources, but should be a sound and scientific contribution based upon a practical knowledge of entozoa acquired by years of previous research (extended, if possible, by personal observations made in various parts of the country and under every variety of circumstances). It is one thing to give a literary *résumé* of the progress of this department of science abroad, and another to record the actual position in which we stand in respect of entozootics at home. Except by exclusive and prolonged devotion to this subject no great ultimate good can be accomplished. A properly qualified person, always on the alert, could embrace many opportunities of special research which must of necessity be lost to the mere closet report-maker. In illustration of this let me give an instance. In the '*Times*' of Saturday, July 14th, 1866, we read that "Among the claims presented to the Glamorganshire Court of Quarter Sessions, was a claim for poison used in killing stray dogs at Merthyr; another was from the chief inspector of the Swansea police for killing 100 dogs, at 1s. each; while the third was from a person who charged one guinea for the removal and interment of three cartloads of the dead bodies of the dogs." Now, I have no doubt whatever as to the wisdom of destroying these animals; but here is an example of one of those lost opportunities of investigation to which I have alluded. An examination of the bodies of these animals would have been particularly instructive if conducted in relation to the great subject of entozootics. Much more might be said on this head; but I leave it for a future occasion.

18. *Pentastoma tænioides*.—This parasite resides in the nasal cavity and frontal sinuses of the dog, but it is comparatively rare

in England. In the young state, and under a different name (*P. denticulatum*), it is frequently seen in the human body on the continent. Its mode of introduction into the latter "host" has not been ascertained with certainty; yet there can be very little doubt that the sneezing of an infested dog in the face of any person would readily transfer the eggs and embryos of the parasite from one host to the other. In like manner, and by the same means, the ova may be cast over and become attached to food, and then be subsequently conveyed to the human stomach. Fortunately its presence in man appears to be unattended with danger; yet any considerable number of these parasites could scarcely fail to produce more or less inconvenience. In Germany it seems to be rather abundant; for Frerichs (no mean authority) states that it is "far more common in the human liver than the echinococcus." In confirmation of this statement it has been shown to be present in from 5 to 15 per cent. of *post mortem* examinations conducted in different German cities. I have myself frequently encountered this parasite in the juvenile state in animals, but not in the human body. The Pentastomes recently described by Dr. Aitken, from the human liver, belong to another and more formidable species. Strictly speaking, these creatures are not true entozoa, although their habits often cause them to be classed as such. Their mode of introduction into the nostrils of the dog is readily accounted for, since the larvæ are constantly present in the flesh of herbivorous mammals, and must frequently, during the act of feeding, be brought in immediate contact with the dog's nose.

19. *Cysticercus cellulosæ*.—Two or three authors (Gurlt, Chabert, and Hartwig) have stated that the common measles of the pork-tapeworm is liable to occur in the dog; and since we know that it is occasionally found in man, there is no good reason for doubting the correctness of their conclusions. It has been found attached to the membranes of the brain, in the muscles, and in the cavity of the abdomen. If the dog were a thoroughly suitable "host," this larva would in all likelihood be much more common in the canine bearer than it is at present supposed to be. The possibility of its occurrence and the probability of its having been frequently overlooked should both be considered in reference to future investigations in this direction.

20. *Filaria trispinulosa*.—This little parasite, once found by Gescheidt in the eye of a dog, is probably only a sexually immature form of *Ascaris*. The specimen, however, was one-third

of an inch in length, and recorded as a female. It does not appear to have since been met with.

21. *Filaria sanguinis*.—Under this title I have a few more words to say respecting the so-called hæmatozoa of MM. Grube and Delafond. These investigators, some years back, examined 480 dogs, and in nearly five per cent. they found *Filariæ* in the blood. The parasites were extremely minute, their diameter being less than that of the dog's blood-corpuscle! There can be no doubt that they were larvæ of some known, or unknown, species of nematode. I have already hinted that these hæmatozoa might be the brood of *Spiroptera sanguinolenta*; yet in only one instance were sexually mature nematodes (of comparatively large size) found in the heart. In this case the authors obtained six specimens, "of which four were females and two males; and they were lodged in a large clot occupying the right ventricle." They measured from $\frac{1}{2}$ to $\frac{3}{4}$ of an inch in length. MM. Grube and Delafond believed they had encountered a new species, and accordingly gave it the long name of *Filaria papillosa hæmatica canis domestici*. In most of the dogs the entire circulatory system does not appear to have been examined; therefore it is quite possible that adult worms may have been present in more instances than the one specified—perhaps in several. If such had been proved to be the case, it might have been fair to have inferred a genetic relation between the microscopic hæmatozoa on the one hand and the worms in the heart on the other. As the matter now stands, we are in doubt as to the true adult representative of these minute *Filariæ*. With the verminiferous blood MM. Grube and Delafond performed a variety of curious experiments, but they did not, so far as I am aware, employ any worm feedings. They satisfied themselves that the hæmatozoa could only live, as such, in the blood itself, and they estimated that the verminous dogs severally entertained from 11,000 to about 224,000 of these larvæ. In no case, however, had the infested animals appeared to suffer inconvenience.

Conclusion.—I have thus, in a condensed form, brought together a large number of facts having reference to the frequency of occurrence and variety of entozoa liable to infest the dog. The way in which I have treated the subject is somewhat novel, my object being to open up a new field of inquiry, bearing more less closely on questions of public health. The full importance of helminthology in relation to entozootics can only be understood by expositions of this kind, based upon investigations extending

over a long period of time. To do justice to the subject, one must not only be acquainted with the commoner forms of entozoa, but also, to some extent, with the rarer. The experimental method enables us to determine the origin and course of development of many forms, and helps us to discriminate between the harmless and baneful species. Systematic zoology, apart from its own abstractedly scientific value, is of great assistance in aiding our arrangement of the facts in a methodical and easily understood manner. A consideration of all the known facts relating to any one particular entozoon often permits us to state precisely to what extent the species is injurious to the human race as well as to the particular intermediary bearer. We are also frequently in a position to point out what circumstances are sure to increase, or, on the other hand, to decrease, the prevalence of any particular species. We can even go further than that, and show how certain forms may be entirely eradicated. At all events, we have it in our power both to diminish the number of human sufferers from entozootics, and to check, if not entirely to prevent, the invasion of these endemics. Substantial results of this kind being patent to all intelligent people, we can afford to disregard the policy of the ignorant who deride our labours. From researches such as these, the Linnean Society cannot legitimately withhold its sympathy, since a recognized department of natural-history science is thus made practically subservient to the public welfare. In the present case, moreover, this communication, though differing somewhat from the ordinary character of its received contributions, is, after all, only a continuation of my other papers which have already been honoured with the Society's approval.

Remarks on the best Methods of displaying *Entozoa* in Museums.

By T. SPENCER COBBOLD, M.D., F.R.S., F.L.S.

THE Council of the Royal College of Surgeons having afforded me an opportunity of remodelling their collection of internal parasites, I have, while thus engaged, introduced a few novelties in the mode of mounting the specimens, and I have ventured to think that a brief notice of them might be usefully placed on record.

Some years' experience with the practical working of museums has satisfied me that for the secure and permanent closure of spirit preparations no plan surpasses the old Hunterian method; but in cases where it is desired to remove the specimens for temporary examination or redissection, the employment of any particular kind of jar becomes a mere matter of taste. The wide glass-stoppered jars are unsightly, inconvenient, and expensive; nevertheless they are preferable to the common medicine-phials now employed in the British Museum. Retaining the Hunterian plan in so far as mere closure is concerned, I would invite attention to the following points:—

1. Except in cases where the specimens are large and bulky, it is always advisable to attach the objects to sheets of mica. The employment of mica is in itself no novelty, but it has been usual to suspend the mineral in the jar with the specimen attached. This is not necessary. It should always be fixed to the sides of the jar, which may easily be done by making the mineral plate a little wider transversely than the corresponding diameter of the jar. The elasticity of the mica, if not too thin, will ensure fixity. I introduced this method ten years ago, and on this principle mounted a series of *Entozoa* in the Anatomical Museum of the Edinburgh University. The form of the jar may vary, but it is essential that the aperture be nearly of the same diameter as the body of the vessel; otherwise, on introducing the specimen, the mica sheet will be injured by too great a strain upon its elasticity. For my own part, I prefer that form of jar first recommended by Prof. Goodsir. In this case (as shown by the preparations on the table) the rim and aperture resemble those of an ordinary hyacinth-glass. This leaves a circular shelf on which Mr. Goodsir used to place a bridge of stout whalebone, and by means of suspensory threads the mica and specimens were attached in the ordinary manner. I have long ceased to adopt this plan. As regards affixing, in the case of complete specimens, it is highly desirable

that their position should be made to correspond with the attitudes which they assume in nature.

2. In the case of Hydatids, and in instances where it is desired to show a large mass of parasites, I have occasionally reversed the above method. Thus, in place of a vertically disposed sheet of mica, I introduce a circular diaphragm of the same substance, its diameter slightly exceeding the width of the jar. The mica should be stout; otherwise the weight of the spirit (on the jar being moved or carelessly inverted) will be sure to displace the diaphragm. It should be carried about two-thirds of the way down the bottle, and be fixed in an obliquely transverse position. The specimens are thus suitably displayed at or near the centre of the vessel. It is unnecessary to fix them to the mica; but, if desired, they may be retained in their place by a second or superimposed diaphragm. Ordinarily this is not advisable.

3. Where the parasites are very minute, yet still sufficiently visible to the naked eye to be worthy of museum display, a thin, square, oblong or circular plate of mica may be applied and fixed to the vertical sheet, including the objects after the fashion of ordinary microscopic preparations. This seemingly simple method, however, required great care and patience; for, in place of using cement, it is necessary to fix the two mica plates together by means of fine thread. In doing this the operator is liable to displace or distort the specimens; but when once accomplished without disturbance, there is no fear of subsequent injury. This method is eminently suitable for the display of Oxyurides, Sphæru-lariæ, and other minute Nematodes, which in our pathological collections are usually seen lying at the bottom of the vessels enclosing them. In some instances, as obtains in the British Museum, I have seen the specimens enclosed in a second vessel or glass tube, the one swinging within the other in a very slovenly manner*.

4. In certain cases where none of the above-described methods are altogether satisfactory, I have introduced another plan which I am particularly desirous of bringing under the Society's notice.

* The Entozoa within our national collection are both numerous and valuable. At present, however, the bottles containing them are lodged within a glass case, the latter being itself placed in a dark passage leading to the so-called "insect-room." The specimens have been skilfully catalogued; but, for want of space, they are huddled together without any definite or systematic arrangement. For the furtherance of the interests of science they are practically unavailable. It is earnestly hoped that Dr. Baird's efforts to secure a proper apartment for their exhibition may yet meet with success.—T. S. C.

It refers to the employment of various-sized watch-glasses. They are affixed to the vertical sheets of mica, and the specimens are introduced into their concavities; each glass being fastened to the mica by threads passed through two or more holes previously drilled at its circumferential margin. I find two holes sufficient, one on either side; but greater fixity and security may be obtained by boring more apertures at equidistant intervals. This adds, however, to the expense and risk of breakage. The holes should freely admit the passage of an ordinary needle. This plan is eminently suitable for the display of small flukes, *Cysticerci* (of the "measle" kind), and minute *Hydatids*.

5. A few years ago I initiated the employment of carmine, aniline, and other pigments in the preparation of Entozoa for museum purposes, and I am glad to be able to state that the specimens thus first treated still retain their colouring almost unimpaired; at least, this is the case with those saturated with carmine. For microscopic purposes, these pigments had long previously being employed both here and on the Continent. Some of the magenta-dyed preparations have stood very well, where the carbolic-acid solution had been sufficiently strong to fix the colour. The specimens preserved in the Museum of the Middlesex Hospital, however, hardly offer a fair criterion of the durability of this latter pigment, since the preparations have been all along exposed to a strong sun-light. In a large collection the use of carmine should not be excessive, but in particular instances (as, for example, in the encapsuled condition of *Trichina spiralis*) its employment cannot be too highly recommended.

[The above remarks were illustrated by the exhibition of specimens of *Hydatids*, *Cysticerci*, *Amphistomata*, *Sphæriculariæ*, *Trichinæ*, *Spiropterae*, and *Cœnuri*, prepared by the author for the Museum of the Royal College of Surgeons.]



